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MISSISSIPPI RIVER VALLEY GEOLOGY RELATION TO RIVER REGIME

By Harold N. Fisk

WATERWAYS DIVISION

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PAPERS

MISSISSIPPI RIVER VALLEY GEOLOGY RELATION TO RIVER REGIME

By Harold N. Fisk[1]

Synopsis

The Mississippi River alluvial valley developed concurrently with the advance and retreat of the final stage of continental glaciation. Sea level dropped as the ice accumulated, and the Mississippi River system eroded a deeply entrenched valley system. A rise in sea level when the ice melted reduced stream gradient, the river was forced to drop its load, and the valley system became filled with a gradational sequence of alluvium. Characteristics of the alluvial deposits show that the river was an overloaded braided stream most of the time that sea level was rising and that the river did not take on its meandering habit throughout the entire length of the valley until sea level reached a stand about 5,000 years ago. The river has developed and abandoned several courses, the positions of which are still visible in traces of river migration or well-defined zones of meander belts. Each ancient course is marked by an alluvial ridge along its meander belt and by a characteristic pattern of distributary streams in its delta area.

Remaining alluvial features show that the river has maintained a close adjustment between its load, slope, and the bed and bank materials. The river is said to be poised because it has shown no tendency either to aggrade or degrade its channel. The adjustment to bed and bank materials is shown by the local and regional characteristics of the channel and by its rate of migration. A broad, shallow, shifting channel is developed in sandy bed and bank materials, whereas a narrow, deep, slowly-migrating channel takes shape in fine-grained deposits. Each of several course diversions has left a clear record of slow and orderly development. The modern Atchafalaya River-Mississippi River relationship suggests an early stage in course diversion.

Note.—Written comments are invited for publication; the last discussion should be submitted by January, 1952.

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Introduction

A great deal of information concerning the surface and subsurface features of the alluvial valley of the lower Mississippi River was collected and analyzed in connection with a geological investigation of the region conducted for the Mississippi River Commission. The project was undertaken to determine the origin and development of the alluvial valley and, from the geological relationships, to evaluate the factors controlling Mississippi River behavior. Results have been published in two reports,[2,3] and those points which demonstrate the relationship between geological features and the river's regimen are briefly summarized in this paper.

The Alluvial Valley

The alluvial valley of the lower Mississippi, a broad lowland varying in width from 25 miles to 125 miles, extends for more than 600 miles across the Gulf coastal plain from Cape Girardeau, Mo., to the Gulf of Mexico (Fig. 1) and covers an area of approximately 50,000 sq miles. This valley is primarily a region of alluviation which has developed as a result of long-continued depositional action of the Mississippi River and its tributaries. Throughout almost the entire length of the valley, the lowland surface, or alluvial plain, is bordered by abrupt walls which gradually lose elevation in a southward direction and disappear where the upland surface slopes beneath the coastal marshlands of Louisiana. The valley walls are breached where the flat-surfaced alluvial plains of tributary valleys merge with the surface of the Mississippi valley.

The continuity of the plain is broken by two ridges: (1) Crowleys Ridge, centrally located in the northern part of the valley, rises 200 ft above the plain and extends for 200 miles south of Commerce, Mo.; and (2) Macon Ridge rises to a maximum of 40 ft above the valley lowlands and extends from Eudora, Ark., to Sicily Island, La., a distance of approximately 100 miles. The plain has an elevation of more than 300 ft at the north end of the valley and has a very low regional slope to the Gulf of Mexico. The slope gradually decreases southward and is practically nonexistent south of central Louisiana.

General Geologic Features

Data from thousands of scattered borings, supplemented by detailed information from several trans-valley lines of close interval borings, show the surface of the alluvial valley to be underlain by a thick mass of alluvial deposits that grade upward from a substratum of sands and gravels into a topstratum of silty sands and silty clays (Fig. 2). The substratum comprises most of the mass at the north end of the valley, where it almost reaches the surface, but near the Gulf of Mexico the substratum is deeply buried beneath the topstratum (Fig. 3). The alluvium buries a rugged valley system in which trenches of the major tributaries extend inland from their junctions with the master trench. The valley walls are the surface manifestations of the margins

[2] "Geological Investigation of the Alluvial Valley of the Lower Mississippi River," by Harold N. Fisk, Mississippi River Commission, Vicksburg, Miss., December, 1944.

[3] "Fine-Grained Alluvial Deposits and Their Effect on Mississippi River Activity," by Harold N. Fisk, Waterways Experiment Station, Vicksburg, Miss., July, 1947.

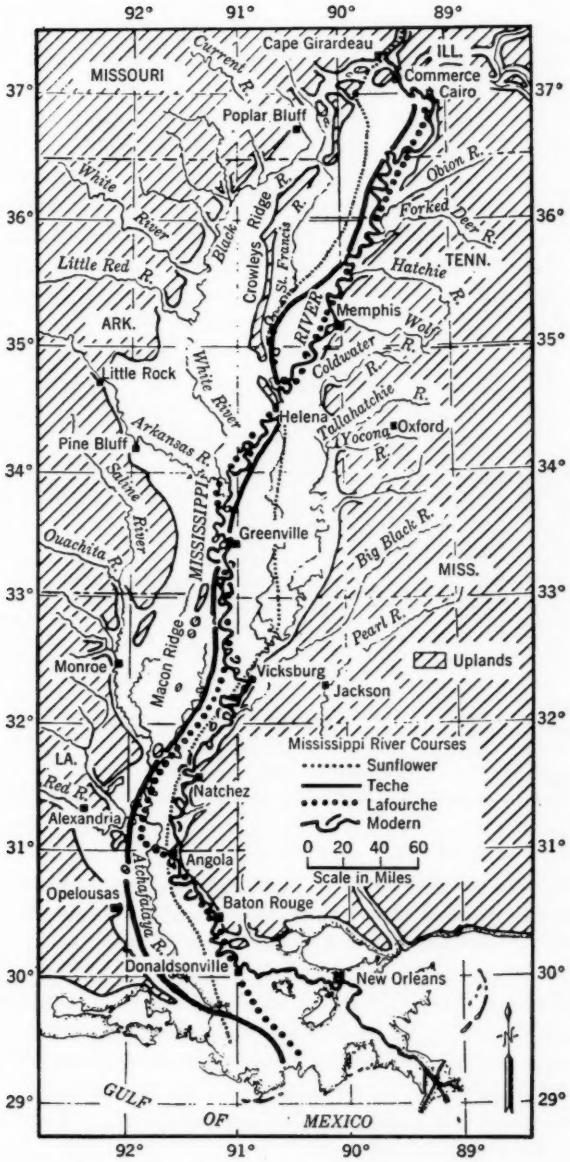

FIG. 1.—THE MISSISSIPPI RIVER ALLUVIAL VALLEY

of the main stream trenches. Crowleys Ridge marks the divide between the upper Mississippi and Ohio River trenches, and Macon Ridge marks the divide between the Arkansas and lower Mississippi River trenches. Divides between minor tributary valleys are all buried beneath the alluvial mass, although they lie near the surface in several areas.

The alluvial valley is actually a valley-in-valley feature reflecting the cyclical events that occurred during the latest epoch of geologic time. The entrenched valley system was eroded during the last glacial stage (late Wisconsin) during the time the sea was being lowered 450 ft as water was withdrawn to form huge glacial ice masses. These ice masses reached their climax of growth about 30,000 years ago. When the glaciers began to disappear, the waters from their melting returned to the oceans and caused the sea to reach its present level approximately 5,000 years ago. Stream gradients were

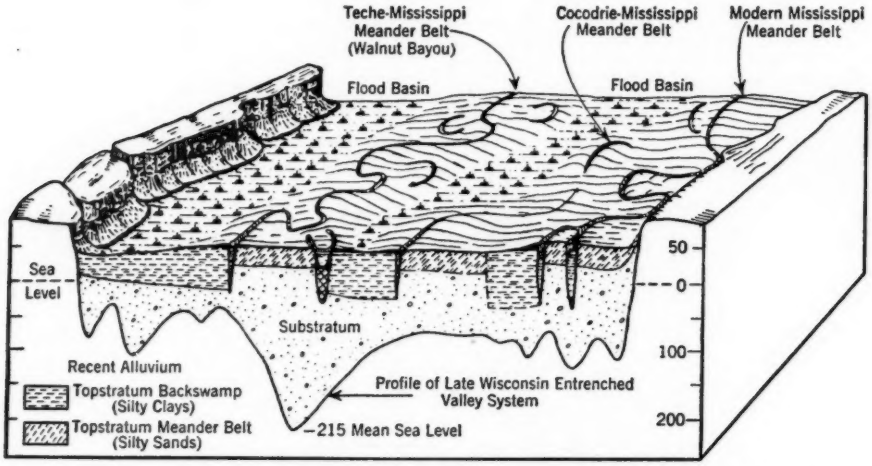

FIG. 2.—BLOCK DIAGRAM OF MISSISSIPPI ALLUVIAL VALLEY IN LATITUDE OF NATCHEZ, MISS.

relatively steep when sea level was low, and sands and gravels were transported beyond the present shoreline. As the sea level rose, stream gradients were progressively decreased, and a great wave of alluvium spread upstream, resulting in the deposition of progressively finer particles (Fig. 3).

The sedimentary mass laid down near the shore of the Gulf of Mexico during and subsequent to the rise in sea level is much thicker than any that could result from a 450 ft rise in sea level. Both topstratum and substratum are present and their combined thickness is more than 600 ft. The excessive thickness of the section indicates that the river mouth region has been sinking during the period of sedimentation.

THE MISSISSIPPI RIVER

The lower Mississippi River starts at Cairo, Ill., at the junction of the upper Mississippi-Missouri River and the Ohio River and follows a crooked

1,000 mile path to reach the Gulf of Mexico. Its course lies close to the eastern wall of the alluvial valley except in the central part of the region, south of Memphis, Tenn., where it swings far to the west of Greenville, Miss. Its flow is divided near Angola, La., where the principal distributary, the Atchafalaya River, starts a relatively short course to the Gulf of Mexico. The main Mississippi River flow continues past New Orleans, La., and then separates into several minor distributaries (or passes) which form the river mouth delta. The master stream is joined on the western side of the valley near Greenville, Miss., by waters of the Arkansas and White river systems, and near Angola by those of the Red and Ouachita river systems (Fig. 1). Tributaries from the eastern side of the valley are all small, the Yazoo River—which joins the Mississippi near Vicksburg, Miss.—being the largest.

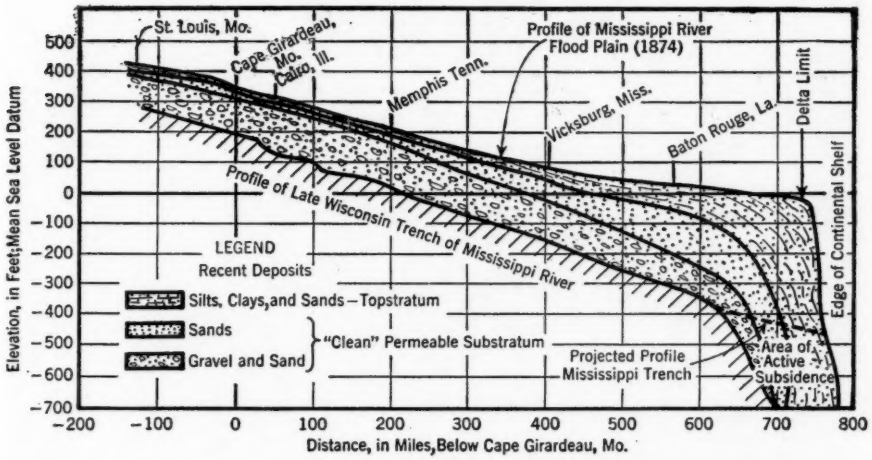

FIG. 3.—GENERALIZED LONGITUDINAL CROSS SECTION OF THE ALLUVIAL MISSISSIPPI VALLEY

An outstanding feature of the Mississippi River is the active migration of its channel. Bank surveys dating from 1765 show that the channel has migrated rapidly and over wide areas in the northern part of the valley. Below Donaldsonville, La., its migration has been very slow, and the shift in river position has been slight. Inequalities in the erosional and depositional activity of the flowing water mass are directly responsible for channel migration. The highest water velocities and deepest channel are at points of bend (bendways) where the thalweg lies close to the concave river bank. Bendways are separated by "crossings" in which the channel is comparatively broad and shallow and the velocities highly variable. Scouring is most intense in the thalweg of bendways, and bank retreat occurs when the concave bank becomes oversteepened and caves into the river. Coarse sediments derived from river bank caving are transported downstream and deposited on sand bars in the shallow slackwater areas along the convex bank of the downstream bend. Thus, the retreat of the concave bank is accompanied by concurrent advance of the

convex bank as a result of accretion. Irregularities in the retreat of the concave river bank are caused by normal changes in channel alinement, resulting from variation in river stage and by local resistance to bank caving. The advance of the convex bank is also irregular and is marked by a succession of sand bar ridges and intervening swales. A bend enlarges as the bank-caving and bar-building processes continue, and the channel may eventually form a meander loop. The history of development of the loop is faithfully recorded in the arrangement of point bar ridges and swales (the accretion topography) within the loop.

Shortening of the river is accomplished by a neck "cutoff" when the upstream and downstream arms of the loop intersect. The ends of the cutoff

FIG. 4.—AERIAL PHOTOGRAPH OF FALSE RIVER, LA.

channel become plugged with sediment, and the remaining portion of the channel forms an oxbow lake which eventually becomes filled with a "clay plug" of silts and other fine-grained alluvial materials. Shortening of the channel is also brought about by "chute" cutoffs which follow a short channel (or chute) across the point bar. Such channels are originally established in swale lowlands between sand bar ridges and gradually enlarge to carry the main river flow. This type of cutoff is more common above Memphis, where it gives rise to a number of large islands.

Channel migration occurs within wide zones called meander belts, the limits of which can be accurately established from aerial photographs and topographic maps. Within such a zone channel migration is indicated by abandoned channels, accretion topography, oxbow lakes, and similar phe-

nomena. Many cutoff meander loops line the channel north of Donaldsonville, and their associated accretion topography provides an excellent tool for interpreting the history of river migration. One of the larger meander loops, False River, La., which was cut off in 1722, is shown on Fig. 4, the aerial photograph mosaic.

The river experienced wide variations in level and under natural conditions frequently overflowed its banks. When the river topped its bank, sediments were piled up in natural levees (wedge-like ridges extending landward from the river bank). These levees are better drained than other flood-plain features and form a large part of the cultivated lands in the valley. A typical one borders the cutoff meander loop occupied by False River. Natural levees line the entire course of the river and, as a result, the stream flows within an alluvial ridge which rises a few feet above the lowland surface.

South of Donaldsonville the ridge is a simple feature made up of broad continuous landward-sloping levees on either side of the channel. To the north, however, it is a complex feature made up of a large number of natural levee elements which border abandoned channel segments within the meander belt, as well as the active channel.

The Alluvial Plain

The surface of the alluvial valley is a wide plain of very low relief that has been constructed through depositional activity of the Mississippi River and its tributaries. The nature and distribution of drainage lines and of such topographic features as natural levees, bar accretions, and old channels provide evidence of long-continued stream action and demonstrate that each of the rivers has occupied and abandoned several courses while the plain has been under construction. Most prominent of the depositional features are the meander belt ridges marking ancient courses of the Mississippi River. Each ridge now holds traces of river activity comparable to that of the modern Mississippi, and each course branches near the coast into a pattern similar to that formed by the Mississippi distributaries. The generalized position of the axial lines of three of the old Mississippi courses is shown in Fig. 1. Although ancient meander belts of the Red, Arkansas, and White Rivers, and other large tributaries are minor features, they are well defined and easily traceable on aerial photographs.

The various alluvial ridges formed by the Mississippi River separate the valley into flood-basin lowlands called backswamps (Fig. 2). Typical of these is the Yazoo River Basin (or "delta") in which floodwaters are impounded between the eastern valley wall and the Mississippi meander belt ridge between Memphis and Vicksburg. Low alluvial ridges, such as the one marking the ancient Mississippi-Sunflower course separate the basin into minor lowland elements. The extensive Atchafalaya Basin in southern Louisiana lies between the alluvial ridges of the ancient Teche-Mississippi course and the modern river. It is separated into minor basins by the alluvial ridge of the Lafourche-Mississippi course and by a ridge along the Atchafalaya River. The heavily forested flood basins hold a complicated network of drainage lines which serve

both to introduce floodwaters and to release ponded waters as a flood subsides. Near the coast the basins merge with grass-covered marshlands and are connected with the Gulf of Mexico through a series of minor bayous and lakes.

The three main sections distinguishable in the alluvial plain are shown in Fig. 5, together with the sedimentary deposits which underlie them. In Fig. 5, the meander belt deposits include bar accretions, channel fillings, and natural levees. The alluvial fan deposits are locally overlain with thin backswamp deposits. Included in these backswamp deposits are fresh water sediments laid down in flood basins. The deltaic plain deposits consist of backswamp, marsh, and marine deposits. The flood plain is the most extensive of these sections and covers a total area of 22,000 sq miles. This flood plain includes all the meander belt ridges and flood-basin lowlands in the valley that were subject to flooding under natural conditions. The deltaic plain is the most continuous section of the valley. It includes the near sea level lands, south of the head of the Atchafalaya River, which bear traces of river distributaries marking the deltas of the several courses of the river. The deltaic plain embraces an area of 13,000 sq miles and merges with the flood plain around its northern margin. The alluvial fan section lies in the northwestern and northern parts of the valley and rises slightly above normal flood level. This section consists of approximately 15,000 sq miles of slightly dissected lands that bear traces of braided stream courses and are the remnants of the old alluvial fans which were built into the valley surface while sea level was rising.

The Topstratum Alluvium

The distribution and lithology of the topstratum are closely related to environments within the valley. The deltaic plain, flood basins, alluvial fans, and several units in the meander belts, all receive deposits of fine-grained sediments and have developed in the course of valley aggradation.

Viewed as a longitudinal unit extending along the valley through its principal environments of deposition, the topstratum is a wedge that thickens in a seaward direction, composed of relatively impermeable deposits grading from thin silty sands at the north end of the valley into a thick, predominantly silty clay mass near the Gulf of Mexico. This wedge is evident in Fig. 3. The topstratum materials everywhere grade downward into the "clean" sands and gravels of the substratum, reflecting the gradual changes which occurred in each of the environments as sea level rose. Along the Mississippi meander belts, where the river scours into the substratum over much of its course, scouring action and river migration have eroded the original topstratum and replaced it with meander belt deposits in which the topstratum element is less widespread and generally much thinner. As a result of meander belt development, the topstratum over much of the valley is divided into a series of long, thick prisms with intervening thinner and less regular masses, as shown in Fig. 2, the cross section of the narrow part of the valley near Natchez, Miss. Thicknesses of the regional topstratum wedge have been measured at several points where this wedge forms the river bank at the edge of the modern meander belt. The elevation of the base of the topstratum at these points is shown by

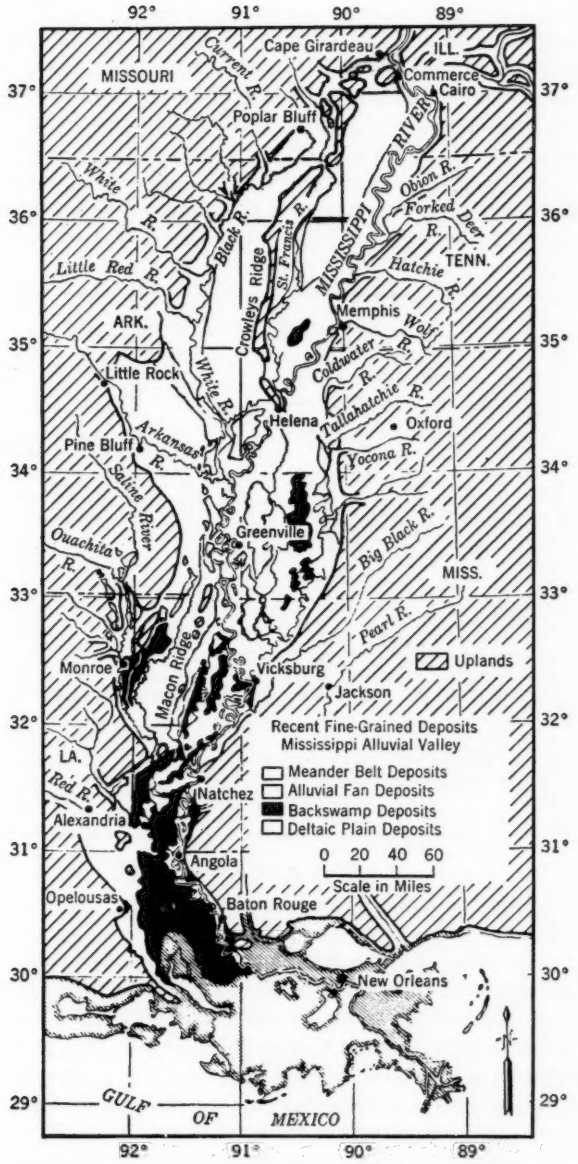

FIG. 5.—GENERALIZED DISTRIBUTION OF TOPSTRATUM DEPOSITS IN THE MISSISSIPPI ALLUVIAL VALLEY

the line marked "top of clean sand" on the diagram (Fig. 6), demonstrating the seaward thickening of the mass.

The topstratum is most widespread and thickest beneath the deltaic plain, where it reaches a maximum thickness of over 300 ft (Fig. 3). Here it consists of materials laid down in several brackish water and marine environments, such as marshes, lakes, bays, beaches, and the gulf bottom. Near its margins the topstratum also includes fresh-water deposits laid down in flood basins.

The backswamp deposits are made up of silts and clays carried in suspension by floodwater and dropped in the flood basins. The slow and long-continued accumulation of these beds is reflected in the characteristic sequence of homogeneous silt and clay layers that hold successive layers of logs and roots of

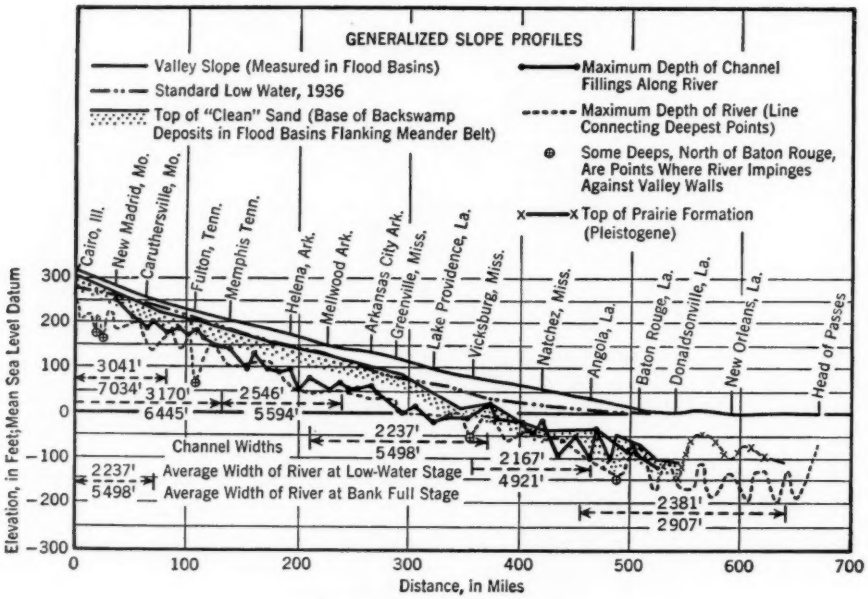

FIG. 6.—SLOPE RELATIONSHIPS

trees in several places. The backswamp deposits form only a thin mantle in the latitude of Memphis where they locally overlie the topstratum of the alluvial fan deposits, but these deposits gradually thicken southward to more than 100 ft in the latitude of Baton Rouge, La.

The topstratum of the alluvial fan deposits is a widespread mantle laid down during the period sea level was rising and the streams had steeper gradients. It is relatively coarse and consists primarily of silty sands with local channel fillings of silty clay. The entire mass is thin, generally not more than 20 ft thick.

Most complicated of the topstratum materials are those laid down in natural levees, point bar accretions, and abandoned channel fillings of meander belts. In the southern part of the valley natural levees are composed mainly

of silty clays and reach a maximum thickness of 25 ft. At the north end of the valley the natural levees are composed of silty sands, and few are more than 15 ft thick. The point bar accretions are blanketed with an irregular thickness of silty sands and silty clays, sand bar ridges are overlain with silty sands, and swales are underlain by somewhat thicker silty clays.

The abandoned channel fillings (or clay plugs) are thicker than any other meander belt topstratum deposit. They are thickest in the position of the channel thalweg in bendways and in the area across the ends of the channel arms in which a deep scour pool forms when the cutoff is accomplished. Fig. 7 indicates generalized thicknesses of the topstratum within the channel and

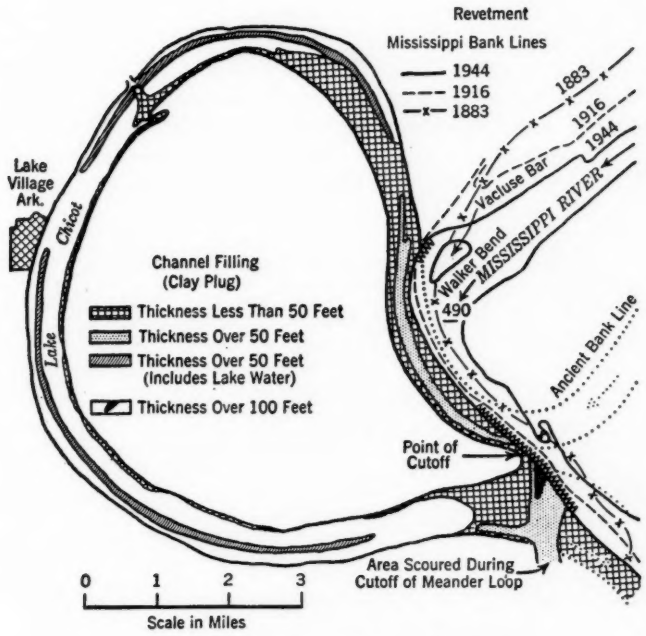

FIG. 7.—LAKE CHICOT CUTOFF MEANDER

over the scour pool of the abandoned Lake Chicot meander, in which the clay plug filling has been adequately tested by borings. The clay plugs have been mapped within the modern meander belt throughout the valley and their thickness, as determined from borings, is shown in Fig. 6. The maximum thickness of the plugs conforms to the maximum depths of abandoned channels and the thickness increases from an average of 60 ft in the north end of the valley to over 120 ft near Donaldsonville.

CONTROL OF RIVER BEHAVIOR BY ALLUVIUM

The characteristics of the Mississippi River reflect the adjustment of its load and great volume of flow to the valley slope and to the bed and bank materials in which its channel is scoured. The river everywhere scours into

the alluvial mass, and its adjustment to the bed and bank materials is well shown by both the local and regional characteristics of the channel and by the rate of stream migration.

The relationship between high stage and low stage channel widths and bed and bank materials is summarized in the profiles of Fig. 6. The channel is wide and shallow at the north end of the valley above Memphis, where the slope is relatively steep and substratum sands and gravels form most of the bed and bank materials below the low waterline. The channel gradually narrows and deepens in a southward direction on the intermediate valley slopes between Memphis and Donaldsonville. These channel changes can be correlated with the gradual increase in thickness of the topstratum throughout this section that extends below the low waterline. Where the river scours into the substratum, its rate of migration has been relatively rapid and has resulted in the development of a wide meander belt. South of Donaldsonville, where the valley slope is low and the river is confined to a thick mass of fine-grained alluvium and valley-floor deposits, the channel is deep and comparatively narrow. The extremely slow rate of channel migration in this section is reflected in the comparative straightness of the stream course.

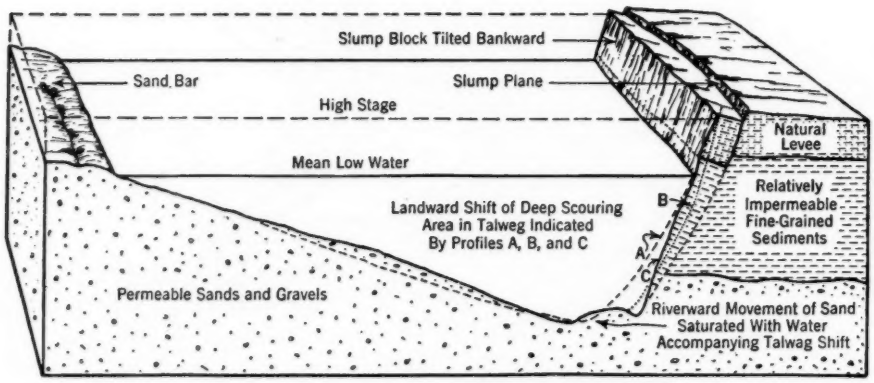

FIG. 8.—BANK RECESSION THROUGH SLUMPING

Topstratum materials effectively hinder local as well as regional channel migration. Thick channel fillings have long been known to form "hard points" that resist bank caving, and thereby alter the shape of the channel cross section and that of river bends, and bring about changes in the river alinement. The greater resistance offered to bank caving by the topstratum as compared to the resistance of sandy bed and bank materials reflects the physical properties of its mass. Inasmuch as fine-grained silty and clayey beds are more cohesive than sands and are relatively impermeable, they are not greatly influenced by fluctuations in hydrostatic pressure resulting from changes in river stage. The topstratum reacts as a unit when the bank caves. Large masses, called slump blocks, slip into the river, rotate, and are tilted bankward (Fig. 8). The resultant indentations give a scalloped bank line. Conversely, bank lines in sandy sediments are smooth because sands behave

as a collection of individual particles and sandy banks continually retreat under river attack through a gradual process called sloughing.

The primary cause of bank caving is known to be scouring in the thalweg of bendways. This has been proved by dredging operations. In order to correct river alinement in some bendways, the Corps of Engineers, United States Army, have dredged in the thalweg and forced bank recession of the concave bank. The principle has also been proved experimentally through careful studies with large models.[4]

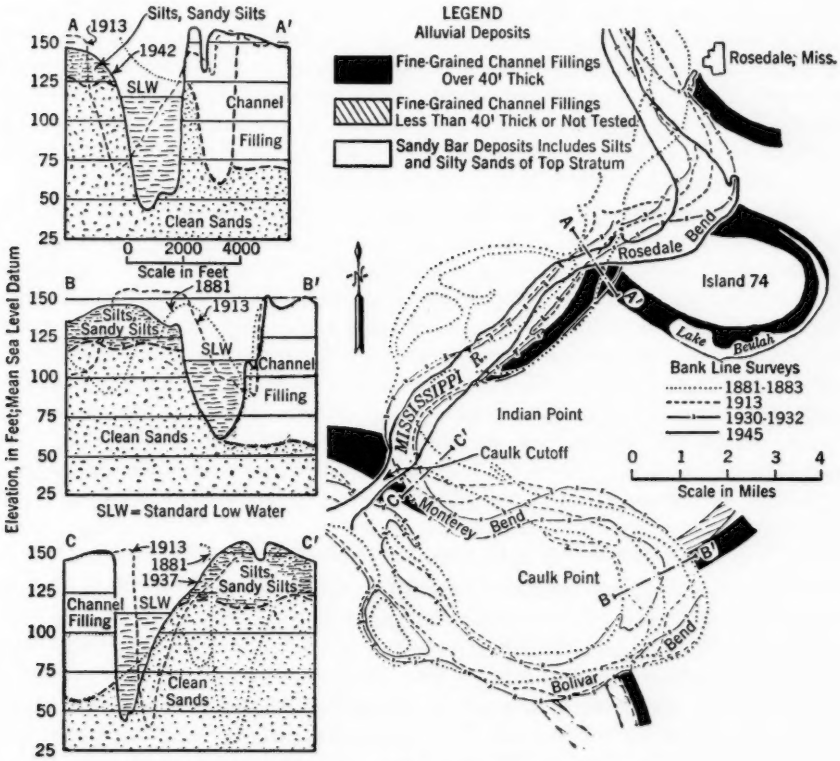

FIG. 9.—CLAY PLUGS ALONG THE MISSISSIPPI RIVER

The general conditions under which slumping occurs are shown in Fig. 8. The position of maximum scouring in the thalweg gradually shifts bankward and destroys conditions of equilibrium that tend to exist between the mass of river water and the water-charged substratum sands. Adjustment is effected by riverward movement of the river bed sands to the point of scouring and results in an undermining of the bank. Riverward movement of sands is possible because the sands are saturated with water that may be under a higher hydrostatic stress than the water in the river. The difference in hydro-

[4] "A Laboratory Study of the Meandering of Alluvial Rivers," by Joseph F. Friedkin, Mississippi River Commission, Vicksburg, Miss., 1945.

static stress may be caused by a falling river stage, a high ground-water level, turbulence in the river, or a combination of these factors. If the bank consists primarily of sandy materials, adjustment is translated upward through the grains, and sloughing occurs immediately. If the bank is formed of the cohesive substratum, however, scouring may proceed until the channel is greatly overdeepened, and the withdrawal of the material from beneath the topstratum causes the bank to collapse and to slump.

Many areas illustrate the control exerted on river migration by thick topstratum materials in local bank areas. An excellent example is afforded by Walker Bend (river mile 490 below Cairo, Ill.), that lies approximately 5 miles downstream from Greenville. Here the western bank of the river is developed against a thick "clay plug," filling the arms and cutoff scour pool of the ancient Lake Chicot meander. Surveys dating back to 1883 show that local channel migration has been slight and local river alinement has remained constant. A slight eastward bulge in the bankline has formed in the vicinity of the thickest part of the clay plug which fills a scour pool over 100 ft deep.

The effect of widely spaced clay plugs on river alinement is illustrated in Fig. 9, showing selected bank line positions between Rosedale (Miss.) and Caulk Cutoff, dating from 1881. The thin abandoned channel filling of the upstream arm of the Lake Beulah meander loop has retreated more rapidly than the thicker clay plug in the downstream arm. As a result of this differential resistance, the channel has changed its alinement and has shifted westward below the Lake Beulah meander. Similar effects of clay plugs on channel migration have occured downstream along Bolivar Bend, an active section of the river's course prior to the artificially developed Caulk Cutoff. The cross sections of Fig. 9 show the influence exerted by channel fillings on both the shape of channel cross sections and the rate of migration of bends.

Valley Floor Deposits and River Behavior

Valley floor and wall materials are all better indurated than the alluvium and are more effective in hindering channel migration and in controlling river alinement. At each point where the river impinges against the valley wall there is an abnormally deep scour hole in the river. (See points on Fig. 6.) South of Donaldsonville the river is actually scouring its channel in tough soils of the Prairie formation buried beneath the topstratum, and several abnormally deep scour holes have developed in the bendways.

Long-Term Stability of the River

The geological history of the alluvial region indicates that the character of the Mississippi gradually changed until the time when sea level reached its stand. After that, the stream became adjusted to its constant base level, and it has now remained relatively stable for a long time. This stable river is said to be poised[5] since it shows no tendency to either aggrade or degrade its channel. The absence of appreciable quantities of silt and clay in the substratum and the presence of many lentils of well-sorted gravels indicate that

[5] "Basic Aspects of Stream Meanders," by Gerard H. Matthes, *Transactions*, American Geophysical Union, Vol. 22, 1941, p. 632.

the Mississippi River was a comparatively fast-flowing, overloaded stream that occupied many shallow channels as sea level rose. At that time the behavior of the river on the steep valley slope was in all probability similar to that of modern braided streams such as the Platte River. The braided character of abandoned channel scars of Mississippi origin may still be seen on the surface of the alluvial fans at the north end of the valley west of Cairo (Fig. 5). The river did not begin to meander until the sea had almost reached its present level. The meandering habit started on the relatively low slope of the valley near the river mouth and gradually developed upstream as valley aggradation progressed and the upstream slope was lowered. Eventually sea level reached its stand, and a permanent adjustment was reached between slope, volume of flow, and load introduced by tributaries. After that the meandering channel of the lower Mississippi developed throughout the entire length of the valley.

River Diversions

Each time the Mississippi was diverted from a long-occupied course, traces of river activity were left in the various meander belts, and the cause of each diversion can be interpreted from flood-plain features. New courses became established in flood basins and developed because their shorter paths to the sea provided a gradient advantage. They appear to have developed slowly and in an orderly manner.

Most of the ancient diversions occurred when an actively migrating Mississippi meander loop reached an adjacent flood basin and intersected a tributary stream that had a channel sufficiently deep and open to carry low-stage flow from the river. Typical of such changes was the shift from the Teche-Mississippi to the modern course near Vicksburg when a migrating meander loop extended to the channel of the Yazoo River. Somewhat different conditions led to the development of the Atchafalaya River that carries a large volume of water from the Mississippi. Mississippi waters enter the Atchafalaya by way of Old River, a short stream which follows a lower arm of an ancient meander loop of the Mississippi. The Red River enters the upstream arm of the same loop and originally joined the Mississippi at the head of Old River. When the meander loop was breached, waters from both the Red River and Old (Mississippi) River flowed seaward through a network drainage channel within the Atchafalaya Basin. It is probable that the original enlargement of the Atchafalaya was accomplished primarily by scouring action of the Red River rather than by that of the Mississippi. As the channel enlarged, an increasing quantity of Mississippi water passed through it.

Ancient courses of the Mississippi, such as the Teche, Lafourche, or Sunflower (Fig. 1), all present excellent evidence of diminishing flow prior to complete abandonment. The full-flow course may be seen outlined on photographs by natural levees and other distinctive features, but, in addition, the channel itself is filled with narrow accretion ridges. These depositional features have caused a narrowing and local straightening of the channel with a few abnormally sharp bends. Because there is no evidence of channel migration accompanying the filling of the channel, it is clear that the stream flow must have been greatly decreased before deterioration set in.

No record of the widening of the new channel is preserved, but the increase in flow is recorded in progressive course lengthening across the deltaic plain. The course grows seaward only after the Gulf bottom has been built to sea level and low natural levees can confine the flow. Many distributaries develop as sedimentation continues, but only those with favored alinements continue to carry water from the river. The final pattern of streams in the delta area is composed of a few large distributaries branching from a main channel near the coast with traces of many abandoned distributaries forking from the channel farther inland. Some evidence exists in this stream pattern that the oldest distributaries had narrow channels and were abandoned in the initial stages of course development during the time the river was carrying less volume.

Judging from ancient diversions, the Atchafalaya-Mississippi relationship illustrates an early stage in course diversion. The Atchafalaya is known to be actively enlarging its channel, and its course is being lengthened seaward. No channel deterioration effects, such as those which mark older courses, are as yet visible downstream in the Mississippi, and it is probable that they will not develop until the main low water flow follows the Atchafalaya.

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